U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

VAN000:
Vehicle Technologies Office Analysis Overview

Jacob Ward, Technology Manager, U.S. DOE/VTO

22 Jun 2021

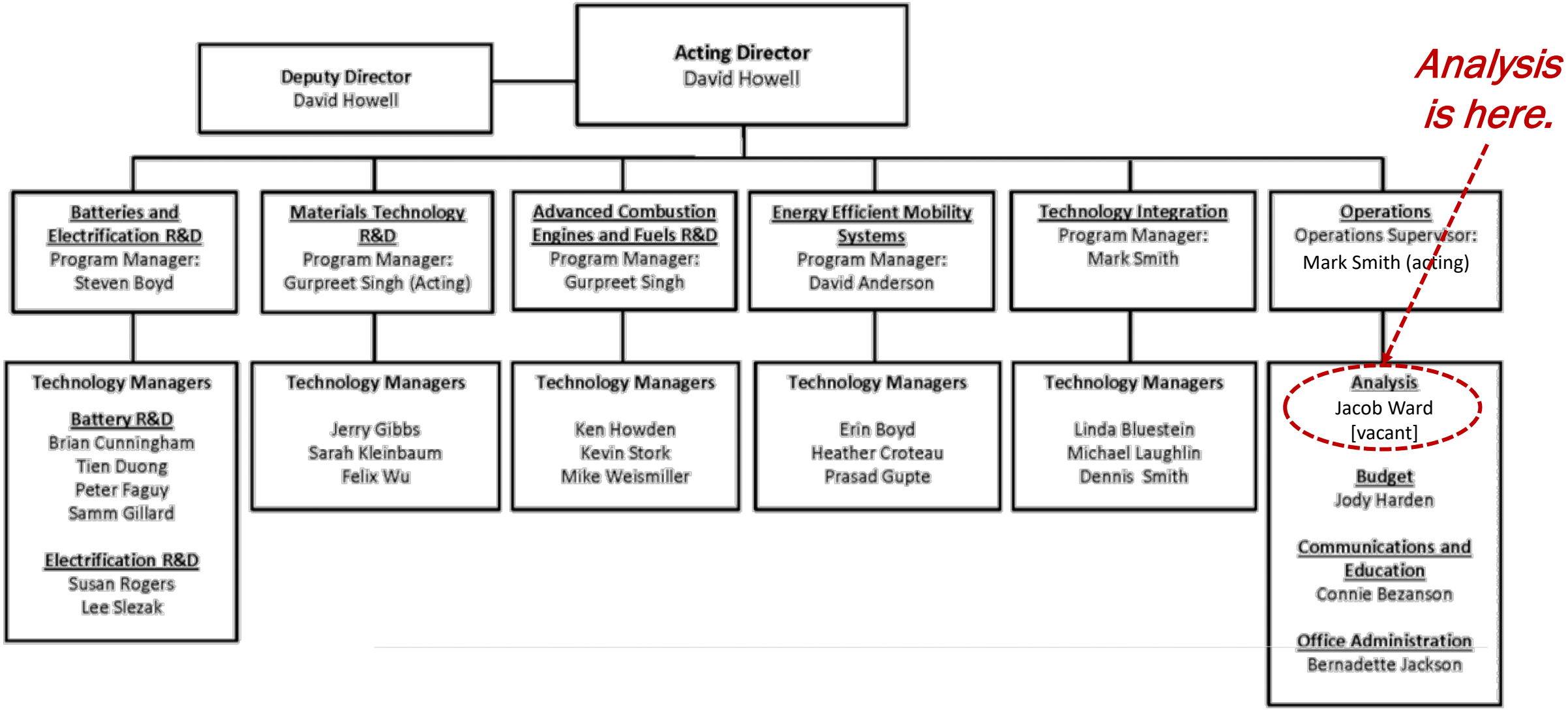
An "Overview of this Overview" Presentation

- **Analysis Team Personnel**
- **Portfolio Strategy**
- **Analysis Program Projects Previews/Summaries**
  - *A contextual framework, then portfolio specifics:*

	Presentation(s)	Poster(s)
– Data	VAN041	VAN016, 032, 042
– Modeling and Simulation	VAN028, 040	VAN018, 023, 043
– Powertrain Choice & Infrastructure Use	VAN021, 034	
– Energy and Emissions Modeling		VAN017
– Integrated Analysis	VAN035, 038, 039	VAN033, 036

- **2021 AMR Presentations Schedule and Posters Online**

Vehicle Technologies Office Federal Staff



Analysis Team Personnel

Mark Smith,
Acting Operations Supervisor

Jacob Ward,
Technology Manager

Raphael Isaac,
Contract Support

Strategic Visioning: Mission

New for soon-to-be-updated VTO Multi-Year Program Plan (MYPP):

VTO Analysis Vision Statement

- **"Develop and manage a portfolio of data-driven, advanced transportation technology analysis to answer critical questions and create insights about energy use and other relevant metrics."**
  - Build and sustain comprehensive core capabilities and expertise to anticipate and respond to immediate office analysis needs and identify longer-term strategic opportunities (i.e., program target-setting).
  - Cultivate bidirectional support for and feedback from EERE leadership, VTO programs, our research community, and other stakeholders.

VTO Analysis Portfolio: Overview of Current Models/Tools

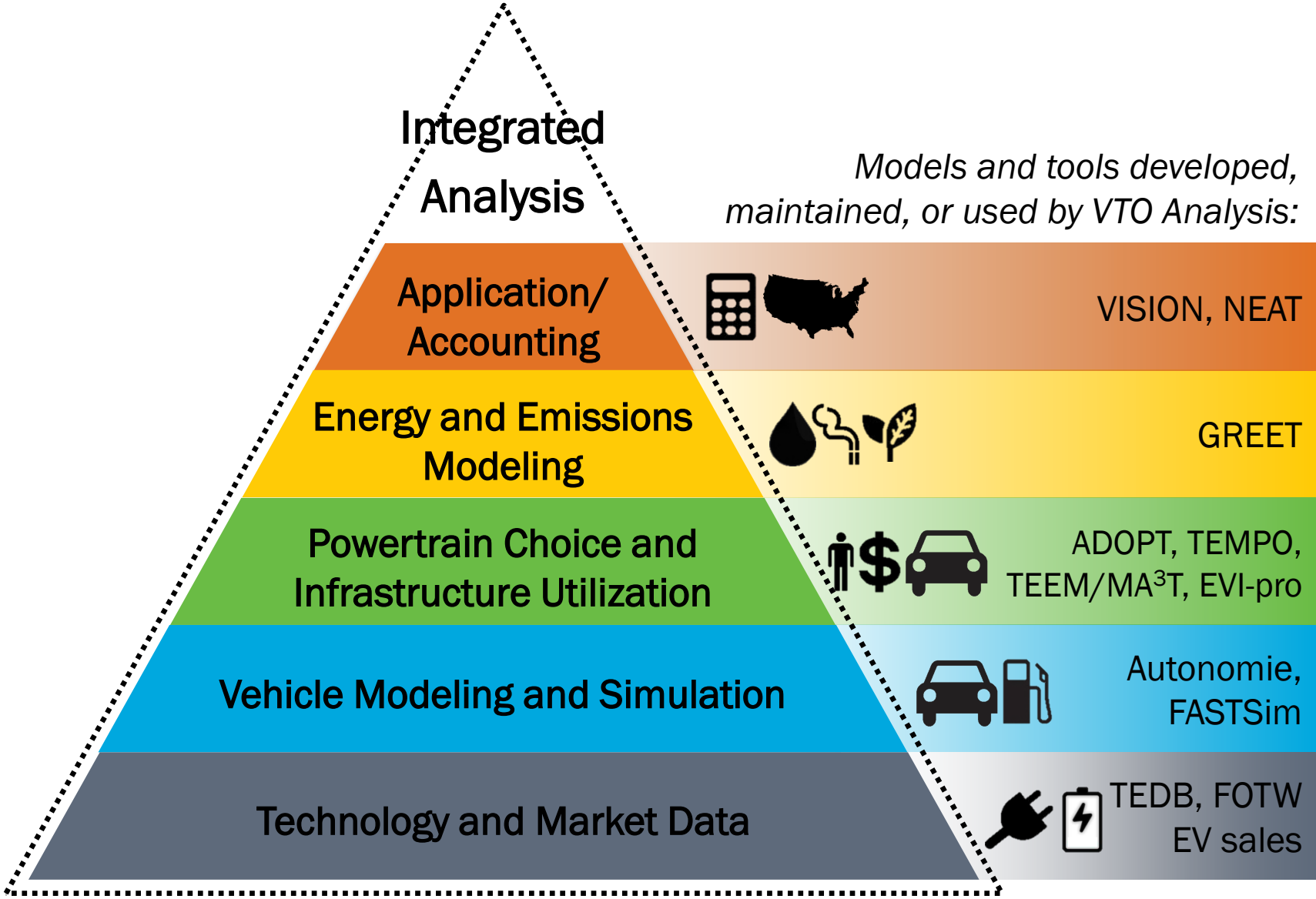
(1) Collect, synthesize, and make public **DATA** and insights

↓

(2) Use data to build, maintain, and expand robust **MODELING** capabilities

↓

(3) Apply models for impactful **ANALYSIS** to answer priority research questions



Transportation Energy Data Book (TEDB)

- TEDB contains **225 tables and 71 figures**
- **Two new updates each calendar year** (January ed. 39, April ed. 39.1, August ed. 39.2)
- Edition 39 features **4 new tables containing data by state**
- **3,590 Google scholar citations**
- **>4,000 website page views, on average, per month in FY21**

https://tedb.ornl.gov

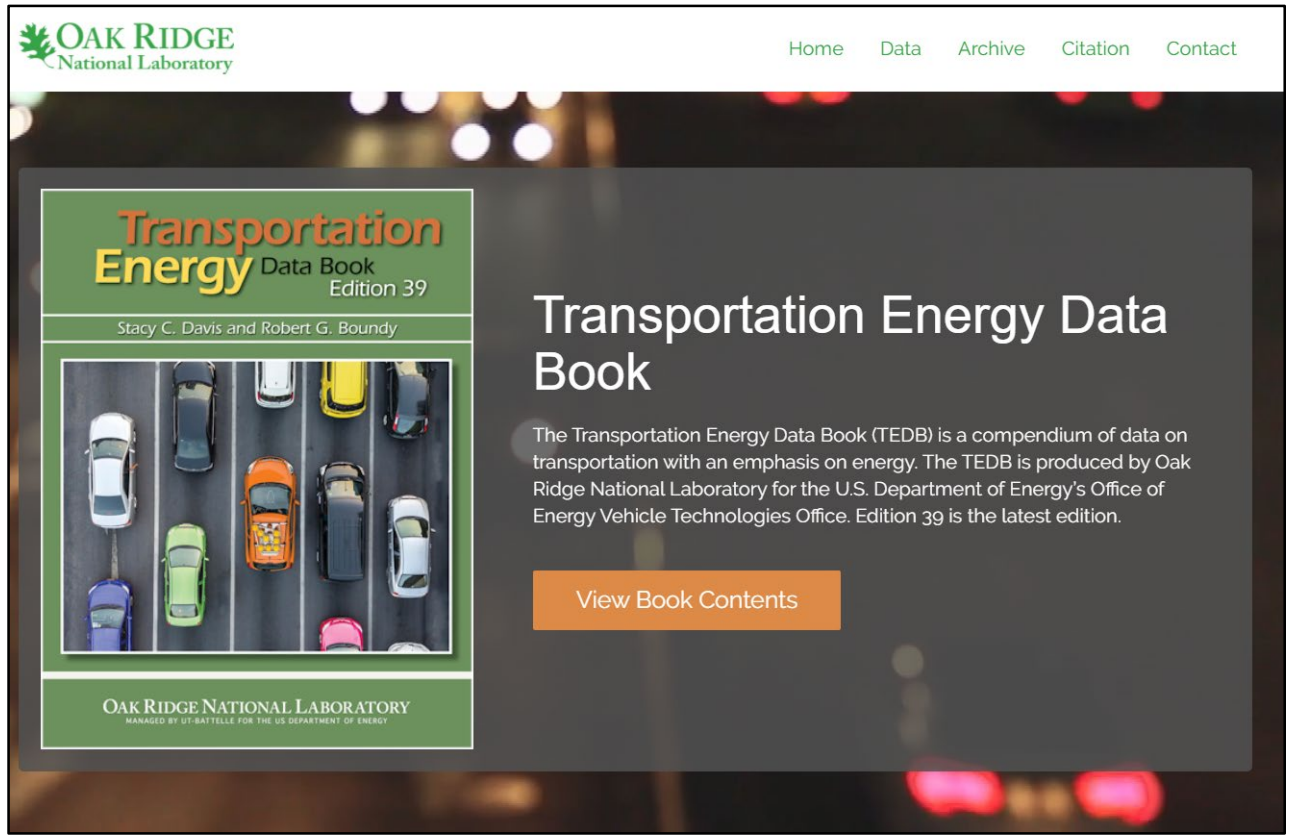
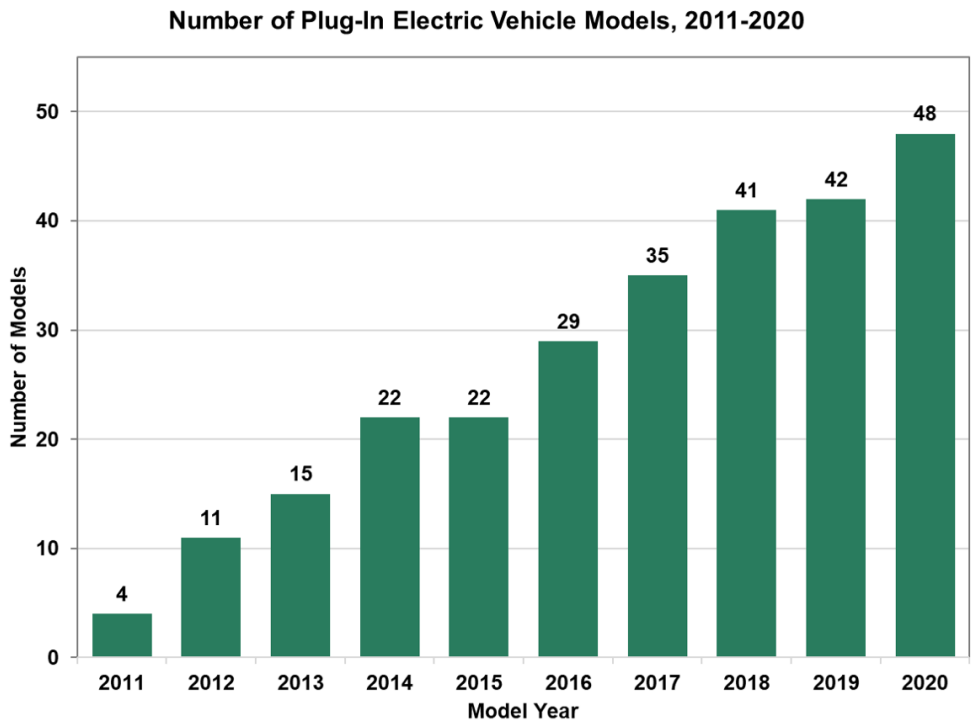


Figure from VAN016 (Davis et al., 2021)

Fact of the Week (FOTW)

- **FOTW** combines a graphic, explanatory text, source, and Excel file
- Recent topics have included:
  - annual fuel cost range for LDVs by technology type
  - number of new EV charging outlets installed in 2019
  - number of available EV models over time (*at right*)
  - state with the highest number of public EV chargers per capita
  - fuel economy loss in cold weather by vehicle type
- >25,000 weekly subscribers, and >247,000 unique pageviews during Q1 and Q2 of FY21

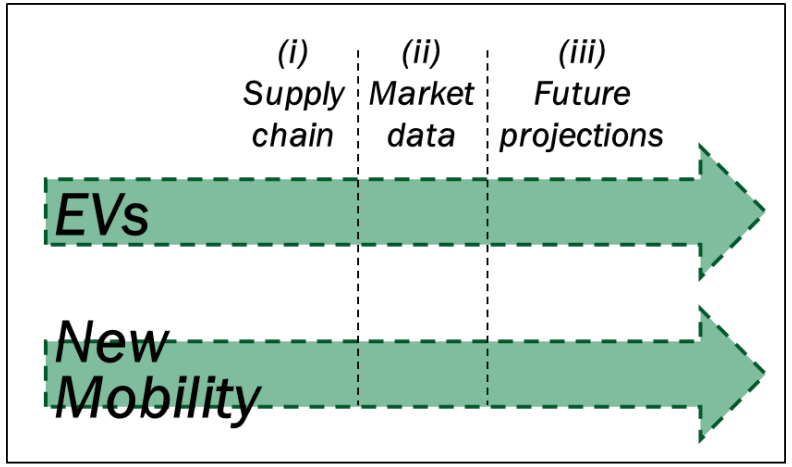


- ***E-mail davissc@ornl.gov to subscribe***

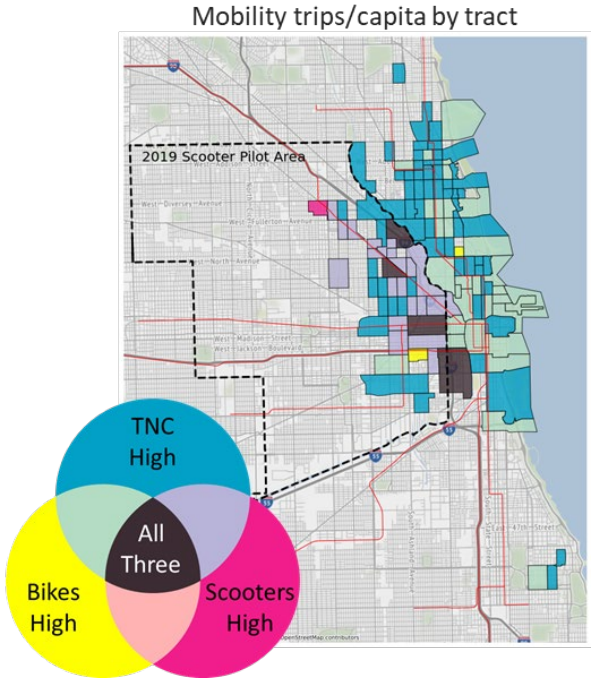
Figure from FOTW, April 19, 2021

Tracking EV and New Mobility Technology

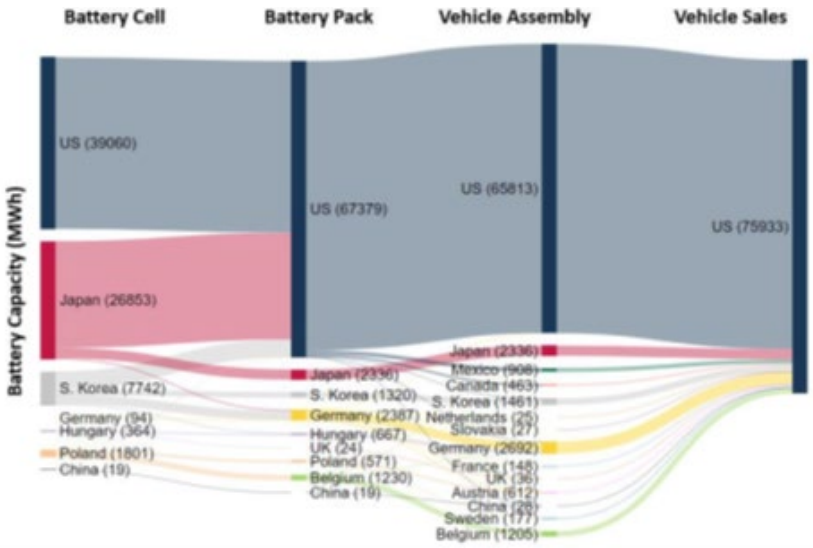
- Technology tracking addresses **new and emerging knowledge gaps for new and emerging technologies.**



- **Example 1:** Collecting market and usage data of **bikeshare, e-scooter, and transportation network companies (TNC)**



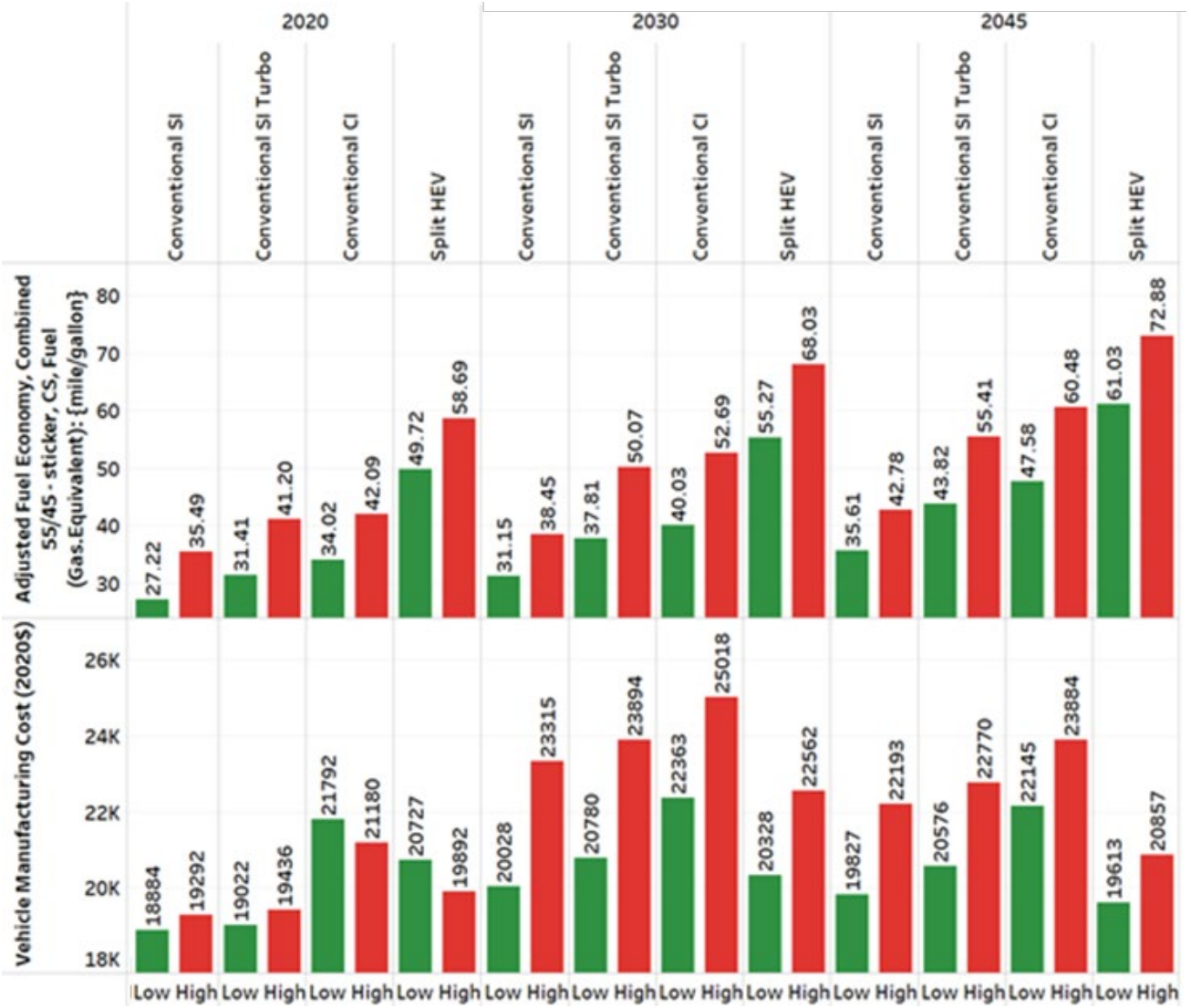
- **Example 2:** **Battery pack production data** demonstrates production pathways for cells, packs, and vehicle assembly for all plug-in electric vehicles sold in the U.S.



Figures from VAN032 (Zhou et al., 2021)

Modeling and Simulation

- ANL's *Autonomie* software quantifies the **energy consumption impact of VTO-supported component technologies.**
- FY21 work modeled **fuel economy (top row) and cost (bottom)** across vehicle classes, powertrains, and timeframes (out to 2045) **with uncertainty ranges.**



Figures from VAN023 (Vijayagopal et al., 2021)

Powertrain Choice (TEEM/MA3T, ADOPT)

Input data → Econometric utility model → Market penetration scenarios

Data

Consumer
- time value, price elasticity, driving pattern

Technology
- Battery cost, fuel economy, range utilization

Infrastructure
- Charger location, number, power; fuel prices

Policy
- Incentive, CAFE, ZEV mandate, HOV access

Decisions

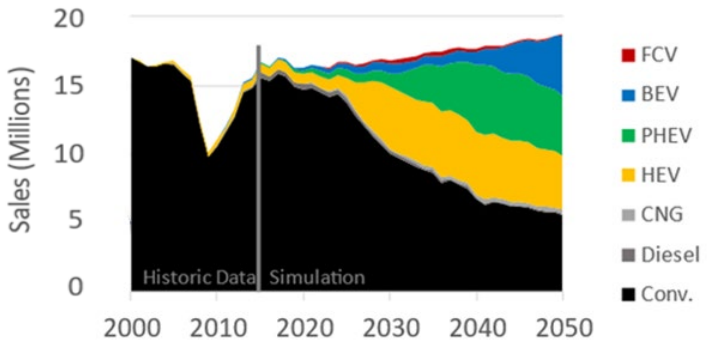
Consumer: choice of fuel, range, mode, VMT

Manufacturer: vehicle price, product diversity

Infrastructure provider: charger network design

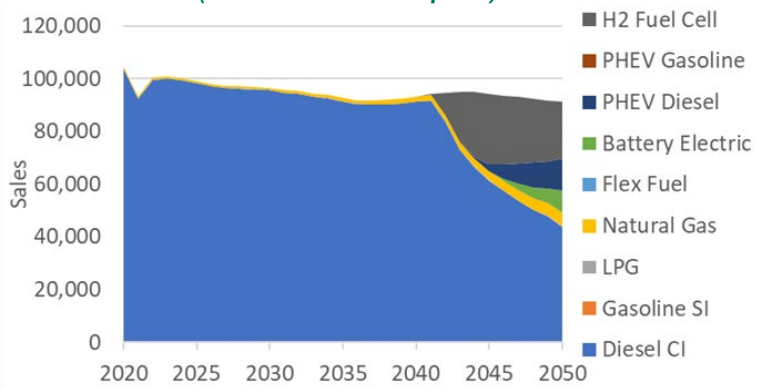
Policy maker: Incentive design, regulation design

Light-Duty



Heavy-Duty

(Class 8 Sleeper)

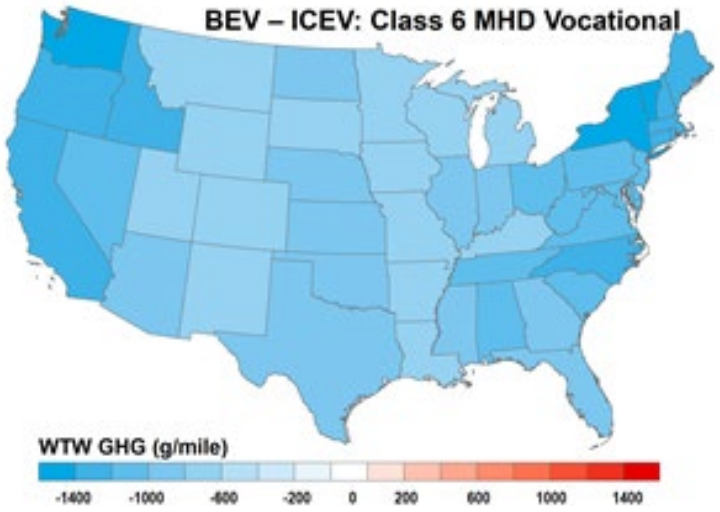


Figures from VAN018 (Brooker et al., 2020){adapted}, VAN021 (Lin et al., 2021), and VAN034 (Birkey et al., 2021)

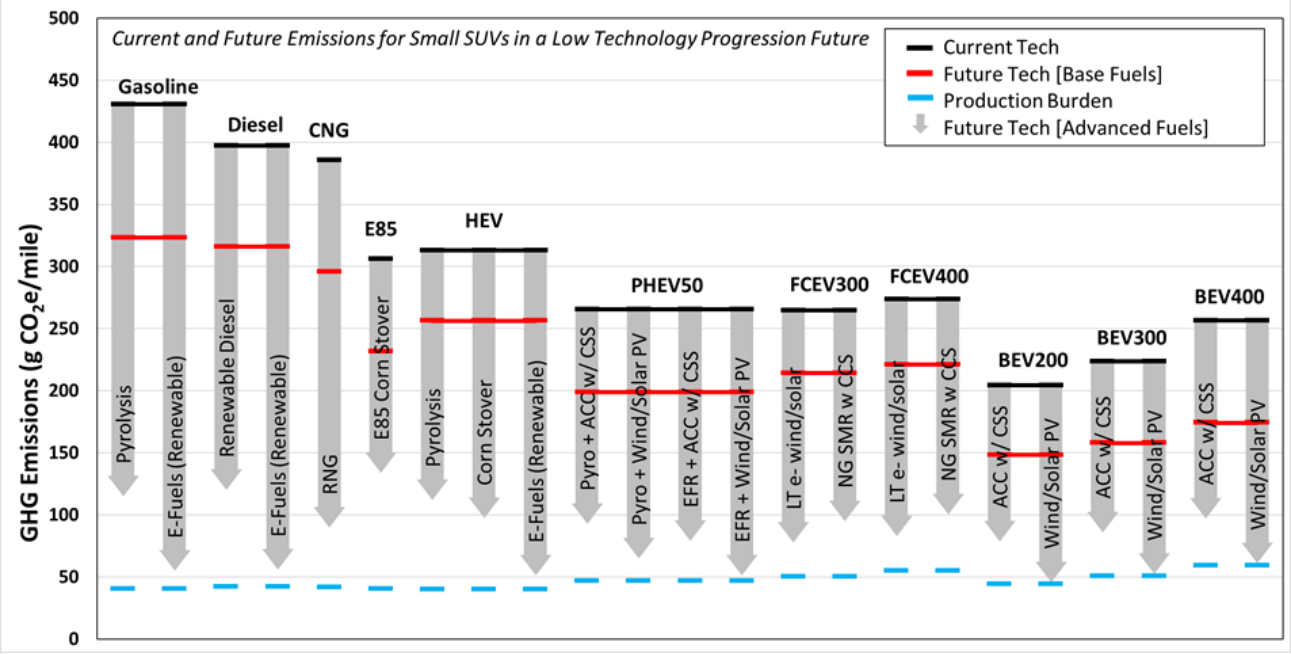
Energy and Emissions Modeling (GREET™)

Selected FY21 tasks:

- Developed sectoral **consumption-based regional electricity characteristics** and conducted a **Well-to-Wheel (WTW) analysis of selected BEVs**



- Performed an integrated system assessment of vehicle/fuel systems to develop **cradle-to-grave (C2G) GHG emissions for small SUVs** and **WTW GHG emissions for M/HDV**

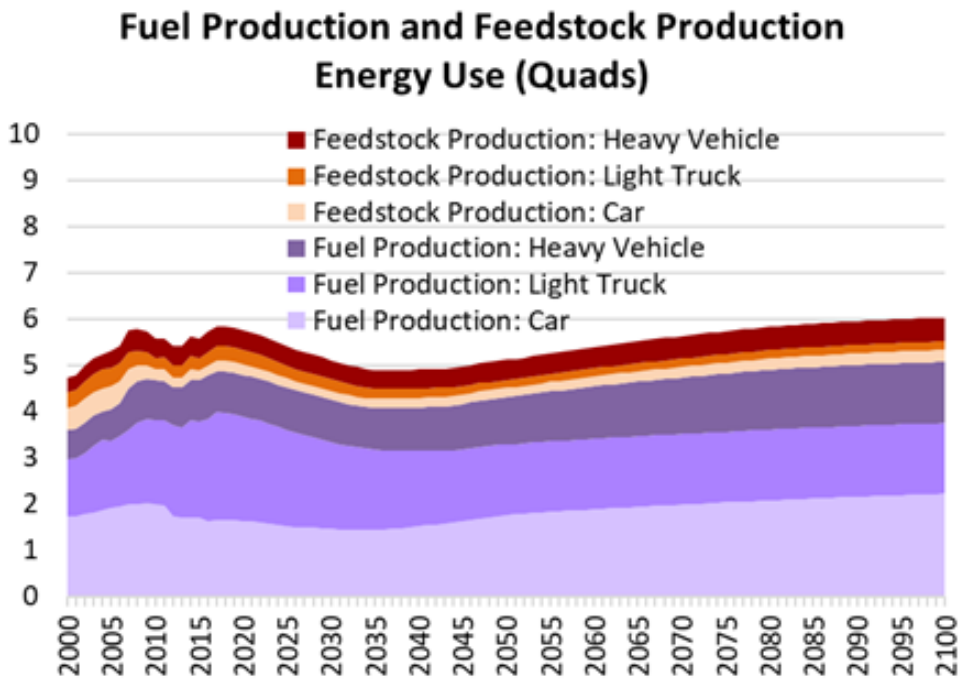


Figures from VAN017 (Wang et al., 2021)

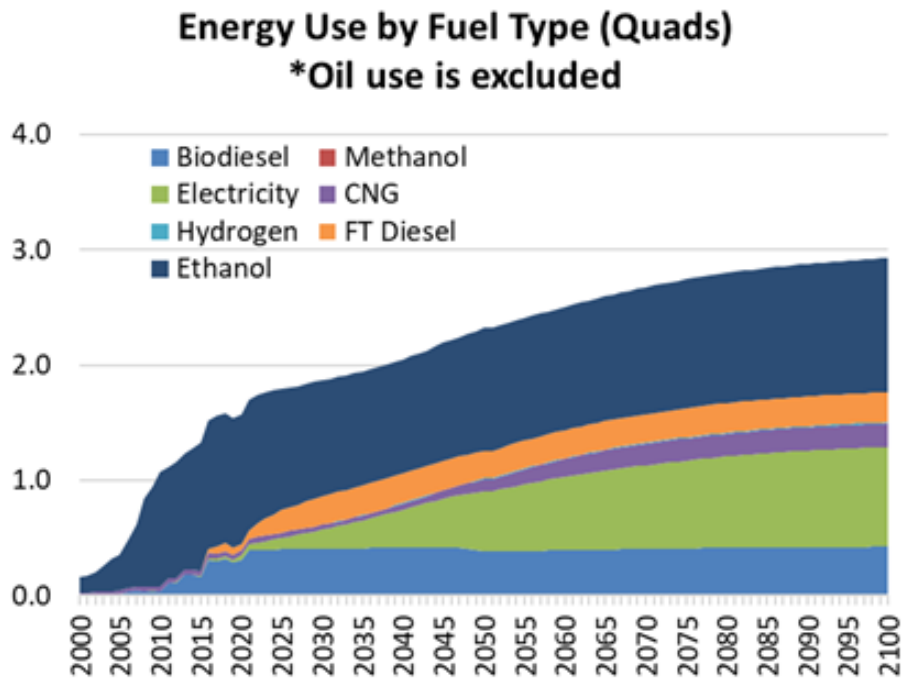
National Transportation Energy Accounting (VISION/NEAT)

- VISION/NEAT estimates **future energy use and carbon emissions** as a function of fleet and efficiency input assumptions

Example 1: *Fuel production and feedstock production energy use*



Example 2: *Energy use by fuel type*

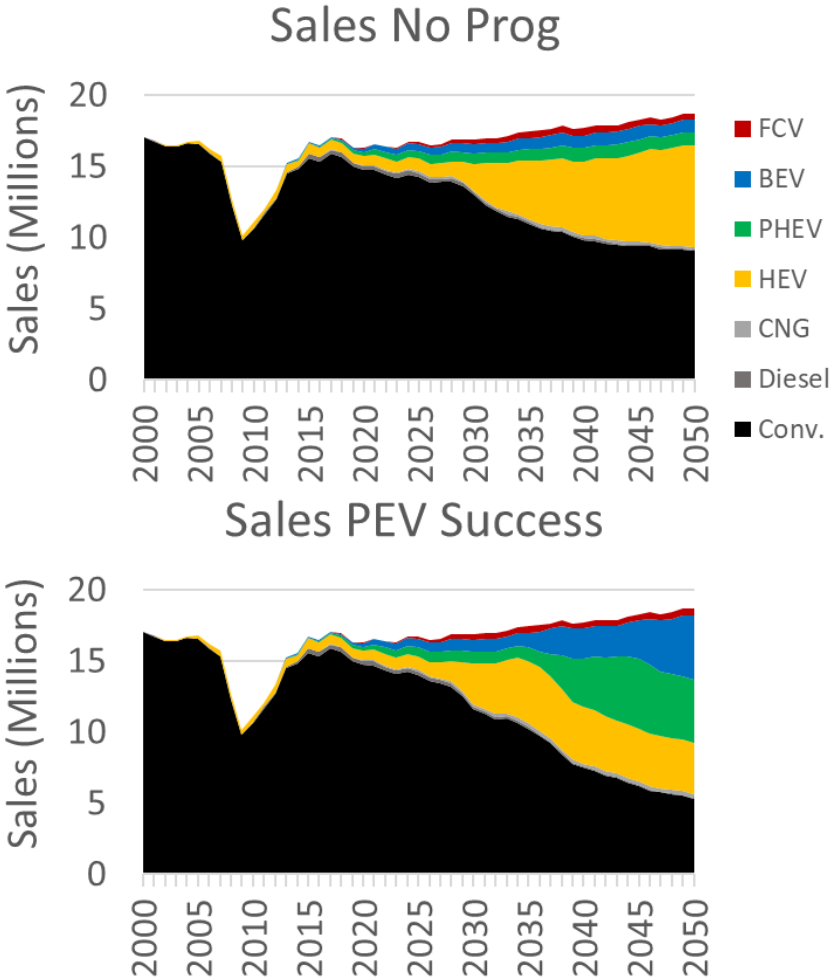


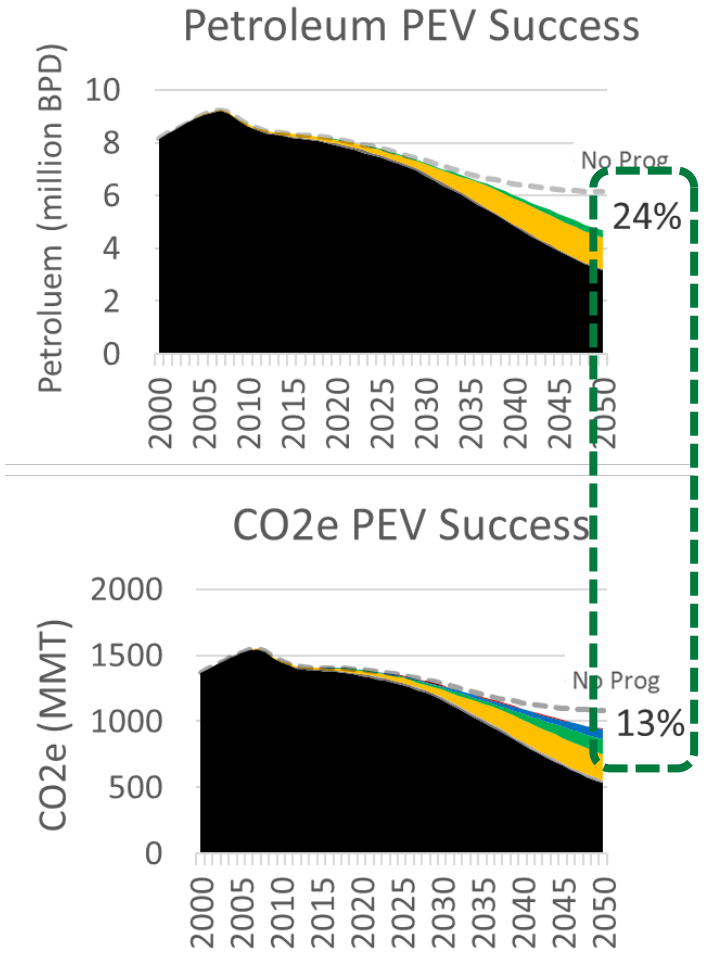
Figures from VAN033 (Zhou et al., 2021)

Benefits Analysis: VTO-Supported Component Technologies

- **Objective**: estimate potential future benefits attributable to VTO (national-level reductions in petroleum use, consumer costs, and emissions)
- **Approach**: compare two scenarios, with and without Approach successful deployment of VTO technologies

Advanced technology changes vehicle fleet mix… → *…and value of national-level benefits.*



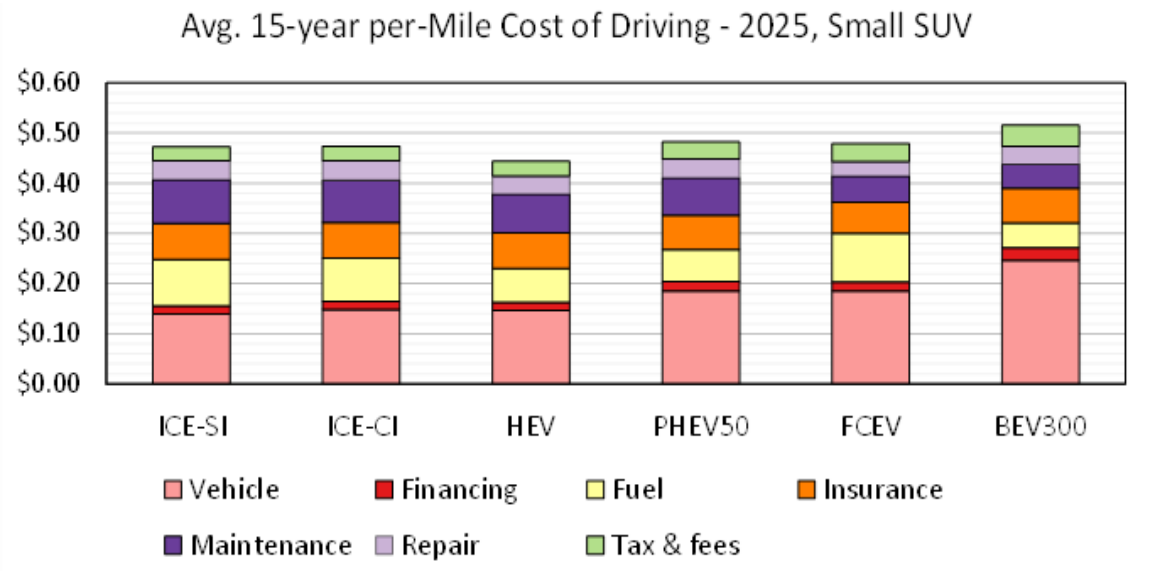


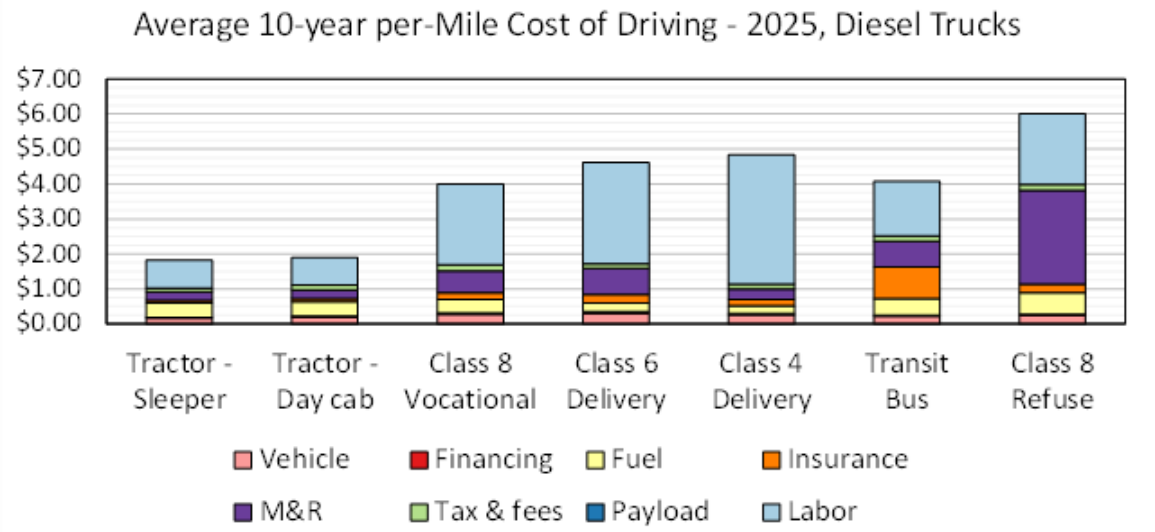
Figures from VAN018 (Brooker et al., 2020)

Comprehensive Total Cost of Ownership (TCO) Framework

- Objectives:
  - Consider all relevant vehicle costs of ownership
  - Leverage existing literature
  - Develop comprehensive, internally consistent perspective
  - Model both (separately) light-duty vehicles and medium/heavy duty vehicles

Cost Components	Major Gaps Addressed
Vehicle	Depreciation; Retail markup
Financing	Loan terms
Fuel	Charging infrastructure
Insurance	Annual & per-mile costs
Maintenance & repair	Annual & per-mile costs
Tax & fees	Registration; taxes
Payload changes	Estimation of payload loss
Labor	Cost of EV charging





Figures from VAN038 (Gohlke et al., 2021)

Today's VAN Presentations

Time*	Project #	Title and Presenter
8:00a	VAN000	**Vehicle Technologies Office Analysis Overview** (Jacob Ward, DOE/VTO)
8:30a	VAN038	**Comprehensive Vehicle Total Cost of Ownership (TCO) Framework** (Dave Gohlke, ANL)
9:00a	VAN035	**Assessing Vehicle Technologies Benefits in a Transportation Energy Ecosystem** (Vincent Freyermuth, ANL)
9:30a	VAN021	**Transportation Energy Evolution Modeling (TEEM) Program** (Zhenhong Lin, ORNL)
10:00a	VAN034	**Medium- and Heavy-Duty Vehicle Choice Modeling and Applied Analysis** (Alicia Birky, NREL)
10:30a		*[AMR break]*
11:00a	VAN028	**Electric Vehicle (EV)-Grid Analysis Modeling** (Fan Tong, LBNL)
11:30a	VAN039	**EVs@Scale** (Michael Kintner-Meyer, PNNL)
12:00p	VAN040	**Energy Impacts of Electrified Passenger Air Transport** (Dominik Karbowski, ANL)
12:15p	VAN041	**Location History** (Venu Garikapati, NREL)

**all times EDT*

VAN Posters (available online):

Project #	Title and Presenter
VAN016	**Transportation Data Program** (Stacy Davis, ORNL)
VAN017	**VTO Analysis Modeling Program** (Michael Wang, ANL)
VAN018	**Light-Duty Vehicle Choice Modeling and Benefits Analysis** (Aaron Brooker, NREL)
VAN023	**Assessing Energy and Cost Impact of Advance Vehicle Technologies** (Ram Vijayagopal, ANL)
VAN032	**Tracking the Evolution of Electric Vehicles and New Mobility Technology** (Joann Zhou, ANL)
VAN033	**Transportation Macroeconomic Accounting Models: VISION and Non-Light Duty Energy and Greenhouse Gas (GHG) Emissions Accounting Tool (NEAT)** (Joann Zhou, ANL)
VAN036	**Distributions of Real-World Vehicle Travel** (David Gohlke, ANL)
VAN042	**Exploring Transit and TNC Interactions using Spatiotemporal Trip Data, (**Josh Auld, ANL)
VAN043	**Off-road Vehicle Electrification Energy Savings Potential** (Vincent Freyermuth, ANL)

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Thank You.

Jacob Ward, Analysis Technology Manager, U.S. DOE/VTO

jacob.ward@ee.doe.gov

202 430 2229